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Date: March 22, 2016

Memo to: Scott Thayer

From: Hardy Strozier BA, MPA, JD, AICP
Megan MacKay BS, MS

Re: Copperopolis Saddle Creek Golf Course Environmental Pond Water Measurements

Introduction, Background and Summary

The TPA assignment is to prepare a follow up study and report evaluation of water demand for the Saddle Creek Golf Course pond and environmental mitigation/water dependent elements. TPA previously provided a report dated August 19, 2015, researching and evaluating the "permit" requirements for water usage in the golf course environmental ponds and associated water elements. This previous report is attached. In order to better gauge the Saddle Creek Golf Course's short and long term water demand needs, we have conducted research, and calculations of the pond's and other water dependent element's water usage throughout a 12 month period. The intent of this report is to allow the owner and public agencies responsible for water related mitigation to better plan, budget, and provide the necessary water for the golf course water elements required by various agency permits.

In this report we will be evaluating four different types of water elements; Ephemeral – these water elements are seasonal and will be dry or wet dependent on natural rainfall and not man made irrigation, Perennial – these water elements are annual and require man made irrigation to meet their permit required water levels, Hybrid – these water elements are both seasonal and annual, and a portion of the pond is required to remain hydrated while the remaining portion may be dry and fluctuate based on natural rainfall, Unregulated – these water elements are for golf play and aesthetic purposes, they can by dry or hydrates at the will of the Saddle Creek Golf Course and are unregulated by any public agency. Distinguishing these four types of water elements is critical in order to calculate the amount of water which is actually required for each pond according to the permits.

Our research, findings, and subsequent calculations provides the golf course with a total savings of 7,574,476 gallons (23.25 acre feet) of water annually. This savings provides a reduction of water use on the permit regulated and non- permit regulated features of over 50 % of irrigation water over a 12 month period. This irrigated water savings derives from no longer needing to provide water for the seasonal and unregulated water elements on the golf course during times of draught. The unregulated and seasonal elements are defined within the environmental permits and associated referenced management plan (See Alexander Plan Attached) for the Saddle Creek Golf Course.

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Pond Holding Capacities

Pitto and Associates, the principal Civil Engineer on the Saddle Creek Golf Course project, created the original detailed civil engineering design for the golf course and its many water elements. Based on the original civil engineering course design Pitto and Associates provided us a Pond Detail Chart (Exhibit A), on this chart each of the golf course pond or water dependent element holding capacities in cubic feet were calculated and recorded. There are 26 ponds on the golf course and all were evaluated for water usage. Some of Pitto and Associates pond volume data was combined for several ponds noted in Exhibit A. For example, the volume for ponds F-2 and F-3 are combined with pond F-1 (See attached exhibit A for all combined pond information). While this combination makes it a bit more difficult to determine how much water is needed for certain individual ponds, we have estimated the individual pond amounts from this data, and determined it will not affect the estimate of overall water needs for the Saddle Creek Golf Course.

Pond Type Determination

We then reviewed the memo "Evaluation and Interpretation of ACOE and CDFW Entitlements for Castle and Cooke's Saddle Creek Golf Course located in Copperopolis, California"(Permit Evaluation and Interpretation memo) written by TPA earlier this year (August 19, 2015). The Permit Evaluation and Interpretation memo (Exhibit B) distinguished what golf course elements, features, and mitigation areas required man-made irrigation and which areas only required water from natural sources i.e. rainfall. The report also identified unregulated ponds. The distinction between seasonal and perennial was made as follows:

> *"Not all jurisdictional "wetland" elements or features are required to be "wet" or irrigated year round. A clear distinction is made in the above documents (2A[1] and 2B[2].) between and among the following features and elements listed below.*
>
> *A. Annual or perennial wetlands and plant life (biota) required to contain or receive water year round.*
>
> *B. Seasonal ephemeral wetlands or grasslands, which only require hydration from winter rains, and not receiving water year round from man-made irrigation." (Permit Evaluation and Interpretation Memo August 19th 2015)*

Included in the Permit Evaluation and Interpretation memo is a graphic taken in part from the Golf Course Water Management Plan by Alexander and Associates (Exhibit B pg 9) which denotes the number of acres in each water dependent element that are Perennial, Seasonal, Hybrid, or Filter Marshes. As you will see in the chart, the four different water element types (Ephemeral, Perennial, Hybrid, and Unregulated) of water elements are all represented. For example Pond A is a Hybrid; with 0.16 acres seasonal, 0.31 acres perennial, and 0.05 acres

[1] Saddle Creek Golf Club, Copperopolis California, Wetland Maintenance & Monitoring Plan by Ralph J. Alexander & Associates dated February 13, 1998.

[2] Sierra Engineering Associates, LTD., Saddle Creek 1999 Record Drawing Wetland Mitigation Plan and Protected Area Exhibit Map for Wetlands U.S. Army Corps Permit NP 26-199100807.

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filter marsh. Thus for Pond A only the 0.31 acres is required to hold water all year, the rest of the pond may fluctuate with natural rainfall.

Perennial Percentage Calculation

In order to translate acreage of each pond into a tangible amount of water need, we decided to calculate a percentage of each of the ponds that is perennial, that is hydrated year around. Data regarding the surface area of each pond differed slightly between the Permit Evaluation and Interpretation memo and the Pond Detail Chart provided by Pitto and Associates, so first we calculated the area of each pond using the numbers from the Permit Evaluation and Interpretation memo which were gathered from the Alexander Management Plan, both of which are attached. We added the number of Seasonal (Ephemeral), Perennial, and Filter Marsh acres for each pond to get an area in acres for each pond.

As an example Pond A has:

0.16 seasonal acres
0.31 perennial acres
\+ 0.05 filter marsh acres
= 0.52 acres total for Pond A

Then to find the percentage of each pond that is perennial we divided the individual pond's perennial acreage by the individual pond's total acreage and multiplied by 100%.

Continuing with Pond A as an example:

$$\frac{0.31 \text{ perennial acres}}{0.52 \text{ total acres}} \times 100\% = 60\% \text{ of Pond A is perennial}$$

We then calculated the baseline volume for each individual pond that would need to remain hydrated to meet the perennial required levels as required by the permits and management plan. The formula we used includes the percentage we calculated as described above as well as the volume data provided in the Pitto and Associates "Pond Detail Chart". For each pond we multiplied the individual pond's perennial percentage by the individual pond's volume in gallons.

Pond A for example: 55,000 gallons total volume for Pond A
60% of Pond A is perennial

55,000 gallons x 60 %= 33,000 gallons to hydrate the perennial portion of Pond A

We used this formula and approach for all the ponds that are regulated by the permit and management plan, of the 26 ponds 16 are regulated by permits and the management plan (the other 10 ponds are unregulated pursuant to the Alexander Management Plan). These amounts are shown in the Baseline Water Needs Chart (Exhibit C). The total number of gallons to meet the perennial holding capacities for all regulated water elements is 2,139,529. This calculation will serve as a baseline, but will not serve as our final number since it does not account for evaporation and ground seepage.

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Past Water Usage

In the most recent past, it was thought that all of the ponds at Saddle Creek Golf Course had to be kept full. However, with last year's drought and CCWD's reduced water deliveries to the Golf Course (both raw water and treated water from their plant), the Community Services District ("CSD") responsible for maintaining the ponds, and Saddle Creek Golf Course were concerned that the lack of water could place the regulatory permits from the Army Corps of Engineers, the Water Board, and Fish and Wildlife in jeopardy of not being able to comply with the conditions of the various permits. However, through our research, we discovered that not all the ponds were to be treated equally; some were not to receive artificial water. As a result of the ponds being kept full, the third party company who maintains the golf course, Golf Maintenance Services ("GMS"), kept track of the date and the amount of water added to each pond at that time. The data that GMS kept not only accounted for each pond's holding capacity but evaporation and ground seepage as well. It is important to know while the water need numbers in Exhibit C are a place to start, Exhibit C does not take into account the data collected by GMS, and is more of a baseline holding capacity. Exhibit E however, does account for GMS's data, and calculates an increment of additional water needed to meet the permit required levels of water for each pond because of evaporation and seepage.

Golf Maintenance Services (GMS) was asked to review the historical golf course water demand data gathered throughout the year 2014. GMS provided to us the amount of water the golf course must add to each pond or water dependent element to keep it full throughout the year (Exhibit D). Again these amounts of water were added under the direction given to the golf course to keep all water elements full year round. The amounts of water in Exhibit D account for the elements holding capacity, evaporation loss, and pond water ground seepage. We had originally set out to calculate the evaporation and seepage rate for each pond, but found that the amount of water added in order to counter act those losses was a more efficient approach as GMS already had that data available.

Perennial Pond Water

In order to determine a more accurate amount of water that each water element will require annually, we used the data provided by GMS and the perennial percentage (hydrated volume for each pond) we calculated earlier in this process. We multiplied the amount of added water to an individual water element provided by GMS in his chart (Exhibit D), by the percentage of an individual water element that is considered perennial.

For example:

> In the year 2014, 1,849,671 gallons were added to Pond A to keep it full all year. We now know that only 60% of Pond A is required by permit to be hydrated.

1,849,671 gallons x 60%= 1,109,803 gallons needed to hydrate the perennial portion of Pond A

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This calculation produced a larger number than the calculations shown in Exhibit C because it is the amount of water that is needed to meet the permit required perennial levels of the individual ponds accounting for seepage and evaporation.

A wet or dry year would affect how much water would be added to the ponds to keep them at permit required levels. With more rain during a wet year less water would have to be added to each of the individual ponds to keep them at permit required levels. While the calculations shown in Exhibit E do not include a variable for rainfall, the calculation was done for the year 2014 which was particularly dry year. Since the calculation was done for a dry year we can assume that the amount of water needed for each pond could only be less than what is calculated in Exhibit E if it were a wetter year, with naturally occurring water entering the ponds.

This calculation or formula was used for all 16 of the permit regulated ponds, and provided us with the number of gallons required to keep the perennial portion of each of the 16 permit required ponds or other water dependent elements hydrated per the permit requirements year round. These calculations can be found in the Evaporation and Seepage Water Needs Chart (Exhibit E). This calculation eliminates man made irrigation from the Ephemeral portions of the golf course's water elements and accounts for water loss at each pond caused by evaporation and seepage giving us a more accurate number of gallons required for each water element.

In GMS's data there were several unregulated elements that were kept full year around. For the purpose of this report, because those elements are not required by permit to have water in them, we will be subtracting those water amounts and counting them as a water savings.

Water Savings

In order to get the most accurate overall water savings required by the permit and management plan, we added up the number of gallons required to annually meet the required Perennial water levels of the different golf course mitigation features found in Exhibit E. This water total came to 7,403,463 gallons annually. In the past, the ponds and other water dependent features have required 14,977,939 gallons of water annually. Overall, providing man made irrigation water for just the Perennial portions of the ponds and not the Ephemeral portions or unregulated ponds will save approximately 7,403,463 gallons of water each year. This savings is about a 49% water use reduction annually.

Cost Savings

Water provided by the Calaveras County Water District costs approximately $182.65 per acre foot. We performed most of our calculations using gallons, but for cost we will convert gallons to acre feet:

Total # of gallons saved per year: 7,403,463 gallons
# of gallons per acre foot: 325,851 gallons

$$\frac{7{,}403{,}463 \text{ gallons}}{325{,}851 \text{ gallons per acre foot}} = 22.72 \text{ acre feet}$$

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Using the calculated total savings in acre feet we calculated the total cost savings annually:

22.72 x $182.65 = $4,149.81

Providing water for only the perennial portions of the regulated water elements will provide a savings of $4,149.81 annually. The Evaporation and Seepage Water Usage Chart (Exhibit E) breaks down the water needs for each pond, and summarizes the total water needs required by permit for the Saddle Creek Golf Course. This analysis resulted in the savings of approximate 7.5 million gallons of water each year.